Ceramic Components for Microturbines at Kyocera

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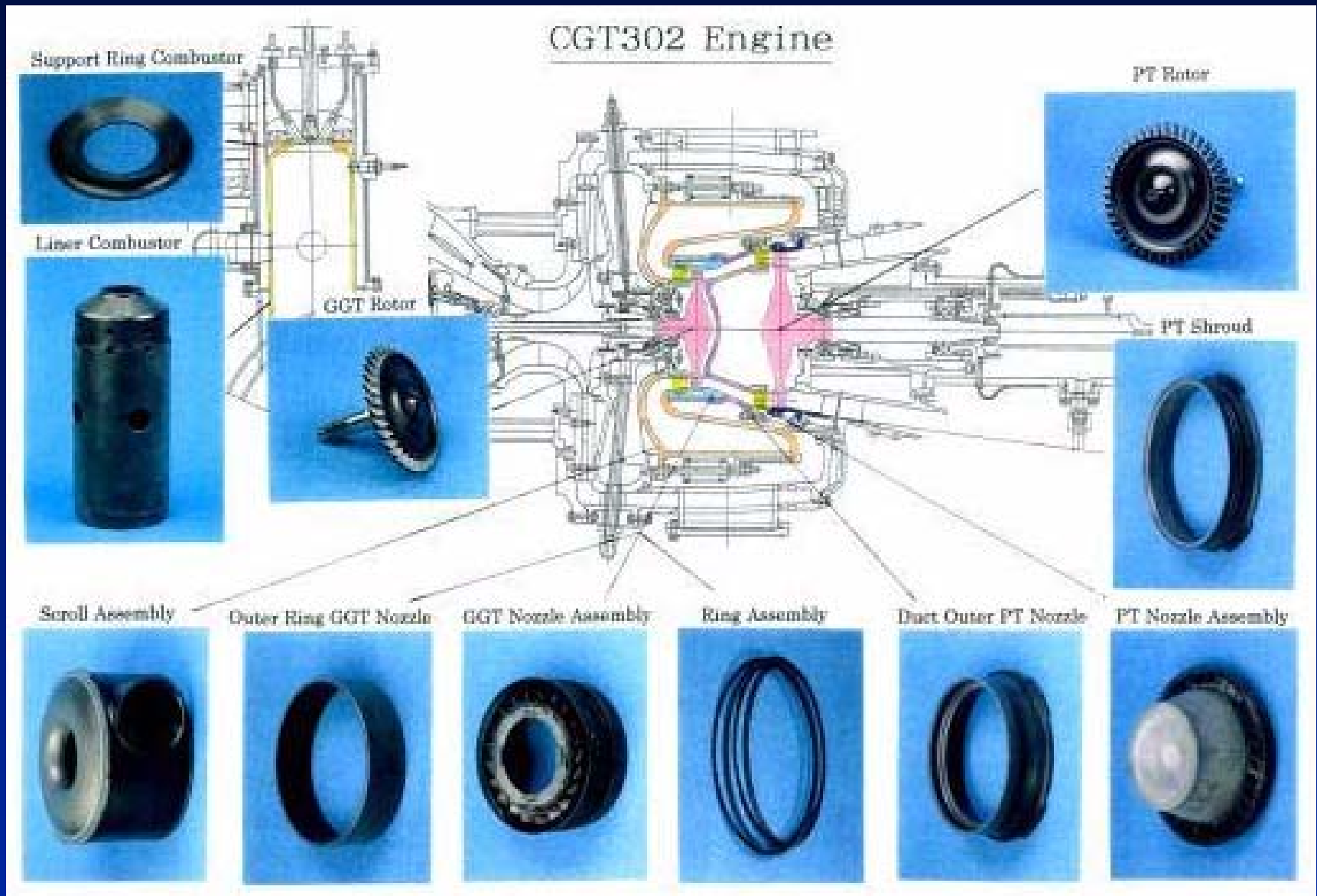
SN281/ 282 CGT 302 Parts



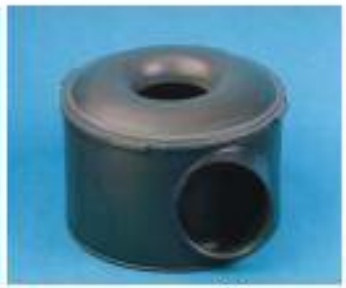
Forming Processes for GT Components, Japan

Forming Process	Application
Hybrid Molding	·Complex Components ·Mass Production
Drain Casting	·Thin Components ·Large Components
CIP	·Thick Components ·Simple Shaped Components

Rotor

Nozzle Segment

Combustor



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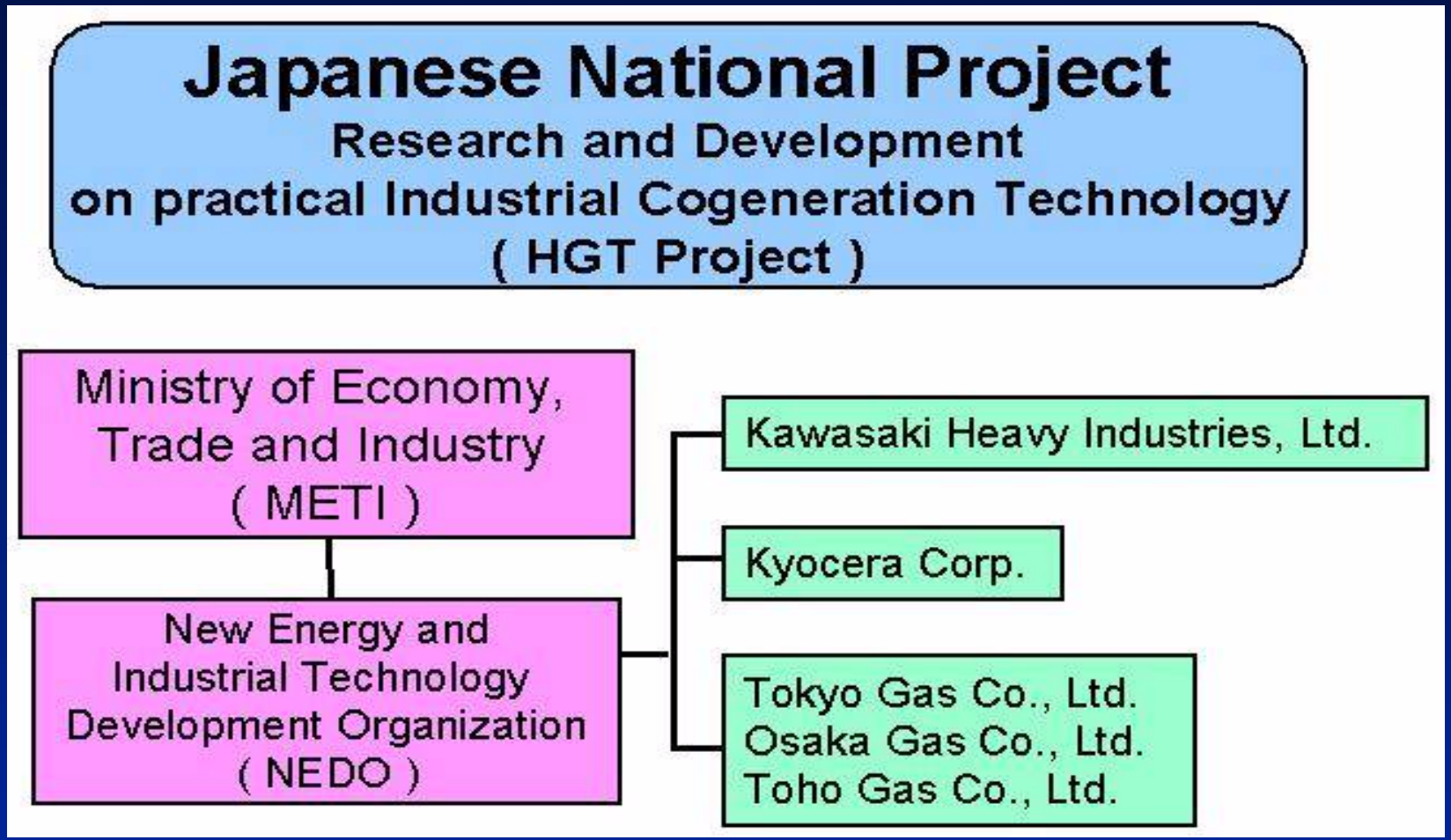
Organization of HGT Project



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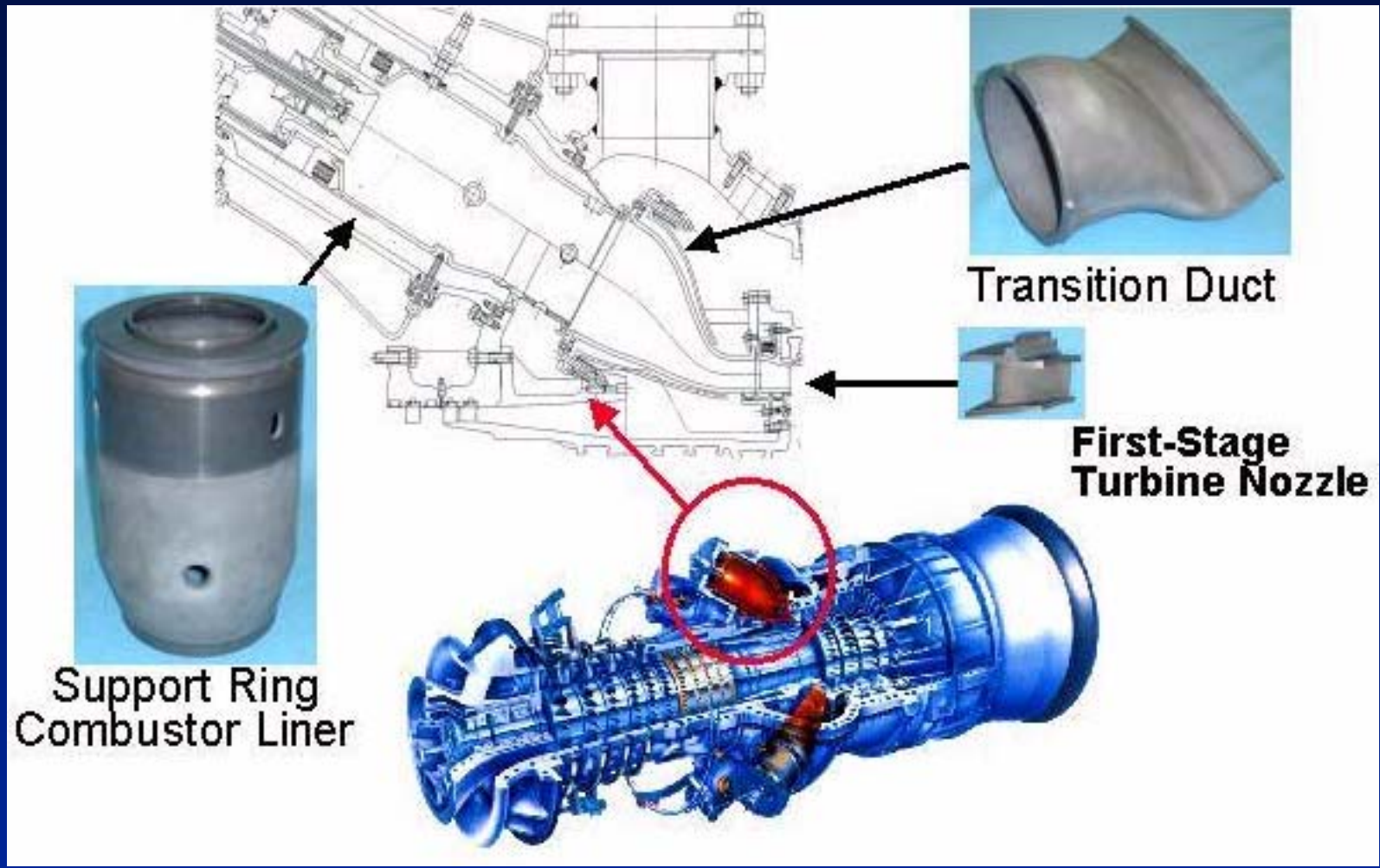
8000 kW HGT Project



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Ceramic Components for HGT

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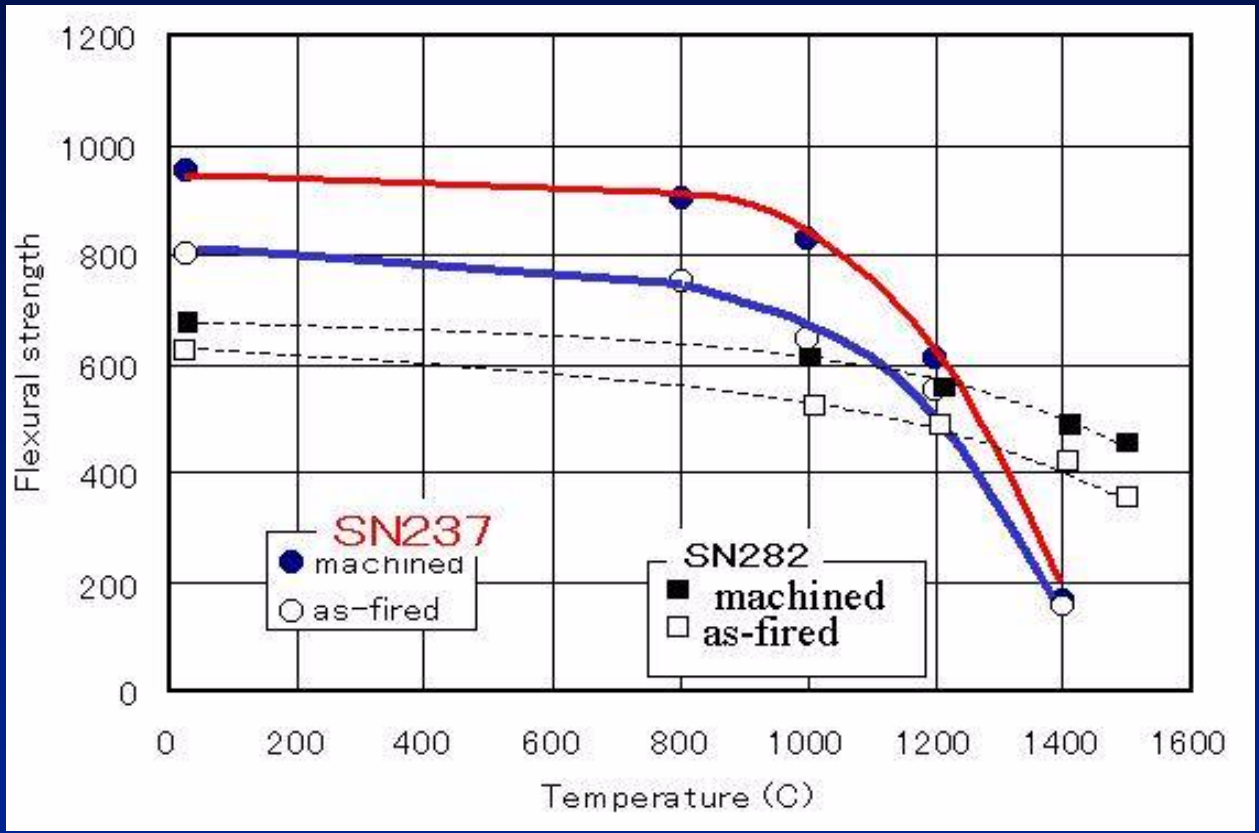
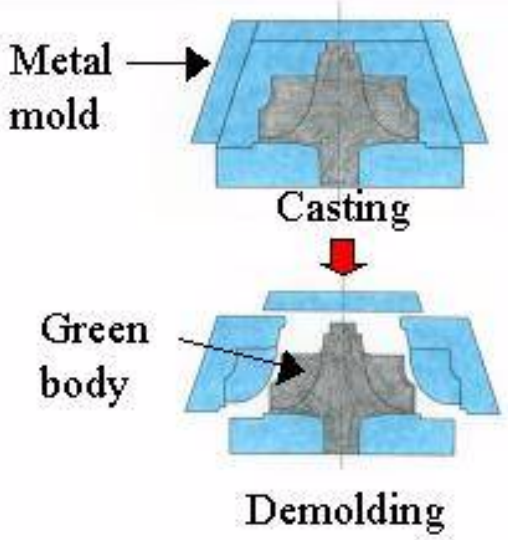
Material for Microturbine Rotor (SN237)

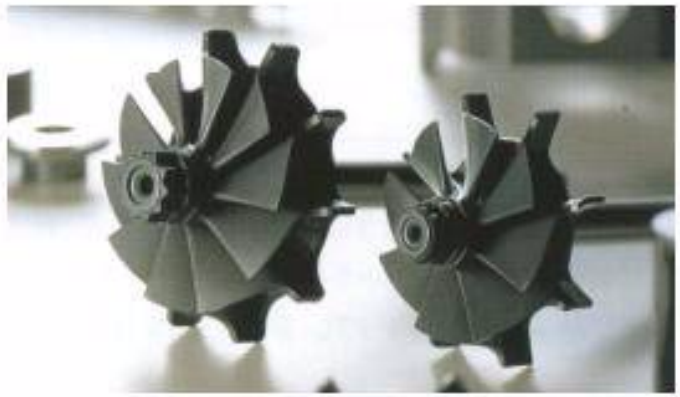


Hybrid Molding for Ingersol Rand Microturbine Rotor

Caracteristics of Forming Processes

	Slip casting	Injection molding	Hybrid molding
Mold	Plaster Mold	Metal Mold	Metal Mold
Pressure	Low	High	low
Binder Amount	Small	Large	Small
Green Density	High	Low	High



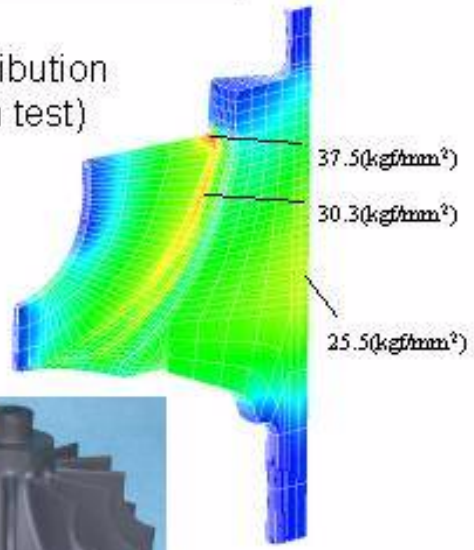


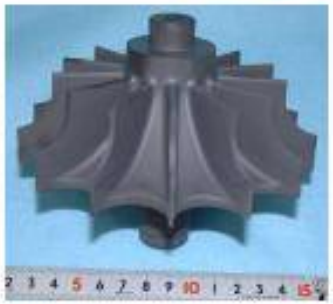
Turbocharger rotor

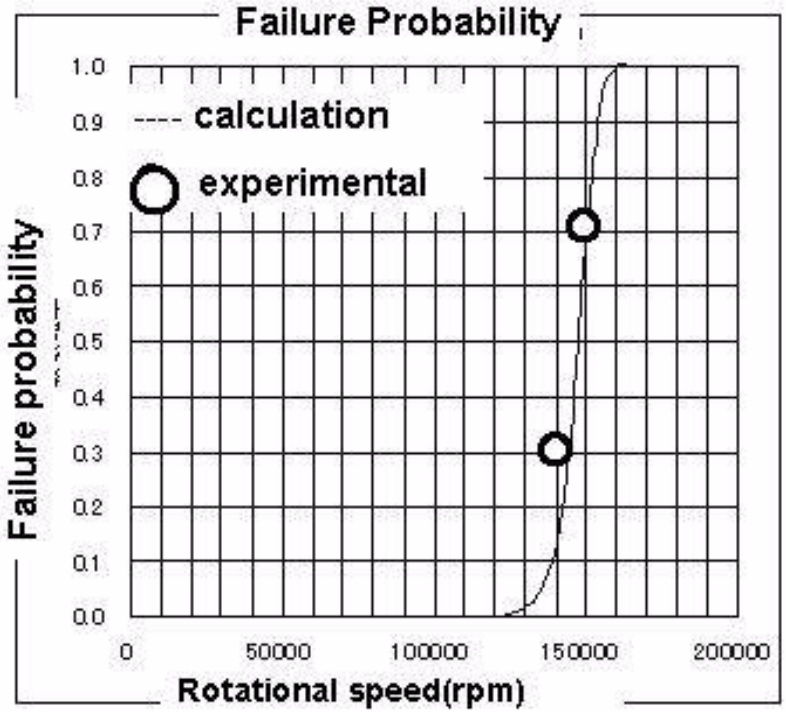
Microturbine Rotor Reliability

Radial rotor (SN237)

Stress distribution
(Cold spin test)



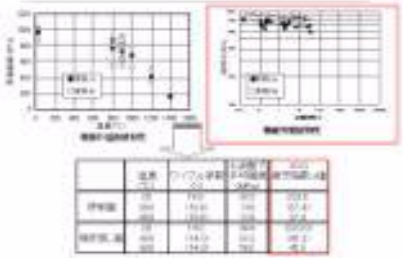




(Straight Blade Rotor (Test Rotor): ϕ125mm)

Microturbine Rotor Life Predicted

Material Data



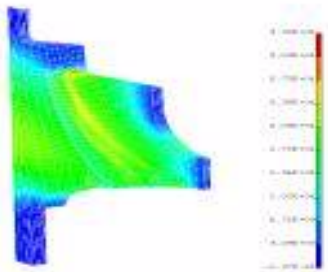
Weibull Modulus

Fracture Strength

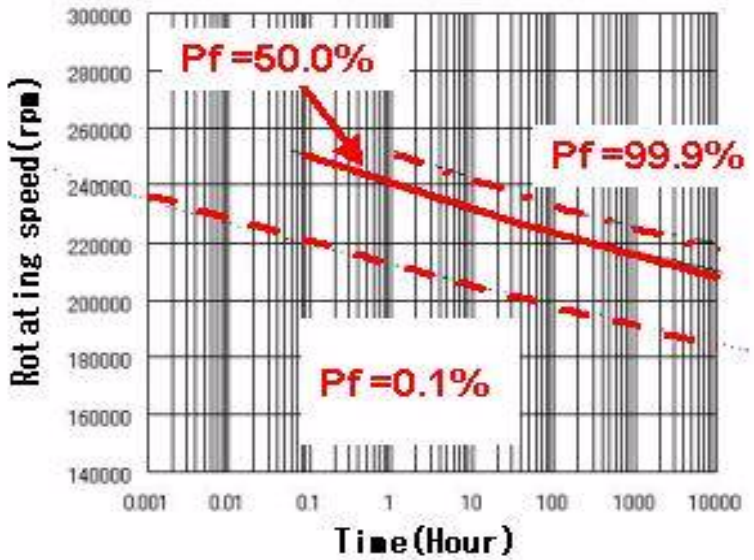
Fatigue Parameters

Stress Analysis Data

(centrifugal + thermal stress)



Life Prediction of Ceramic Rotor

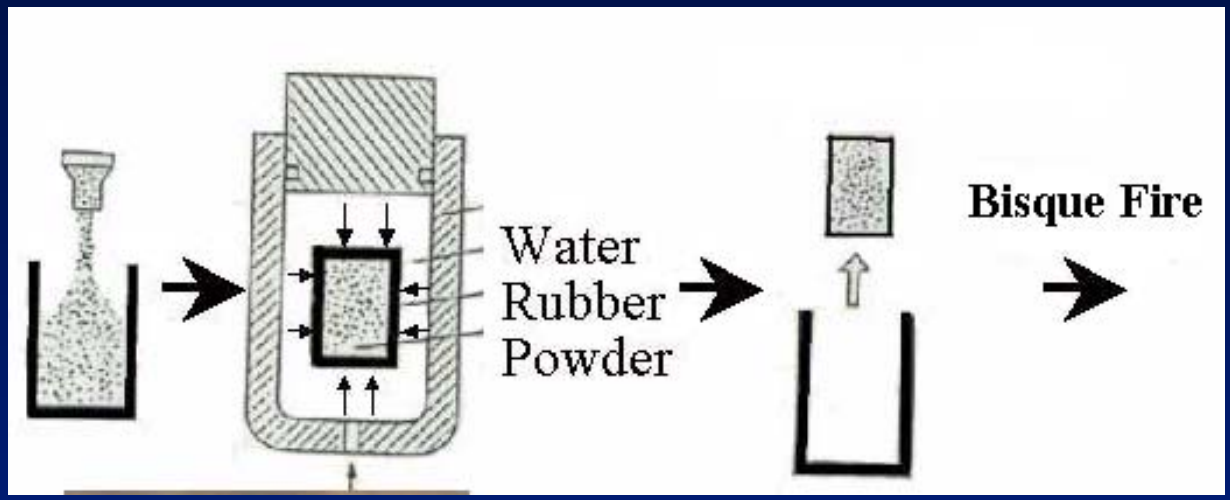


Kyocera Industrial Ceramics

Vancouver, WA

- Automotive Engine Components
- Aerospace Pump Components
- Aerospace Engine Seals
- Gas Turbine Components
- Aluminum Foundry Products
- Semiconductor Processing Equipment Components
- Papermaking Machine Wear Products
- Broad Range of Heat, Wear and Corrosion Resistant Parts

Kyocera, Vancouver Developing Bisque Processing



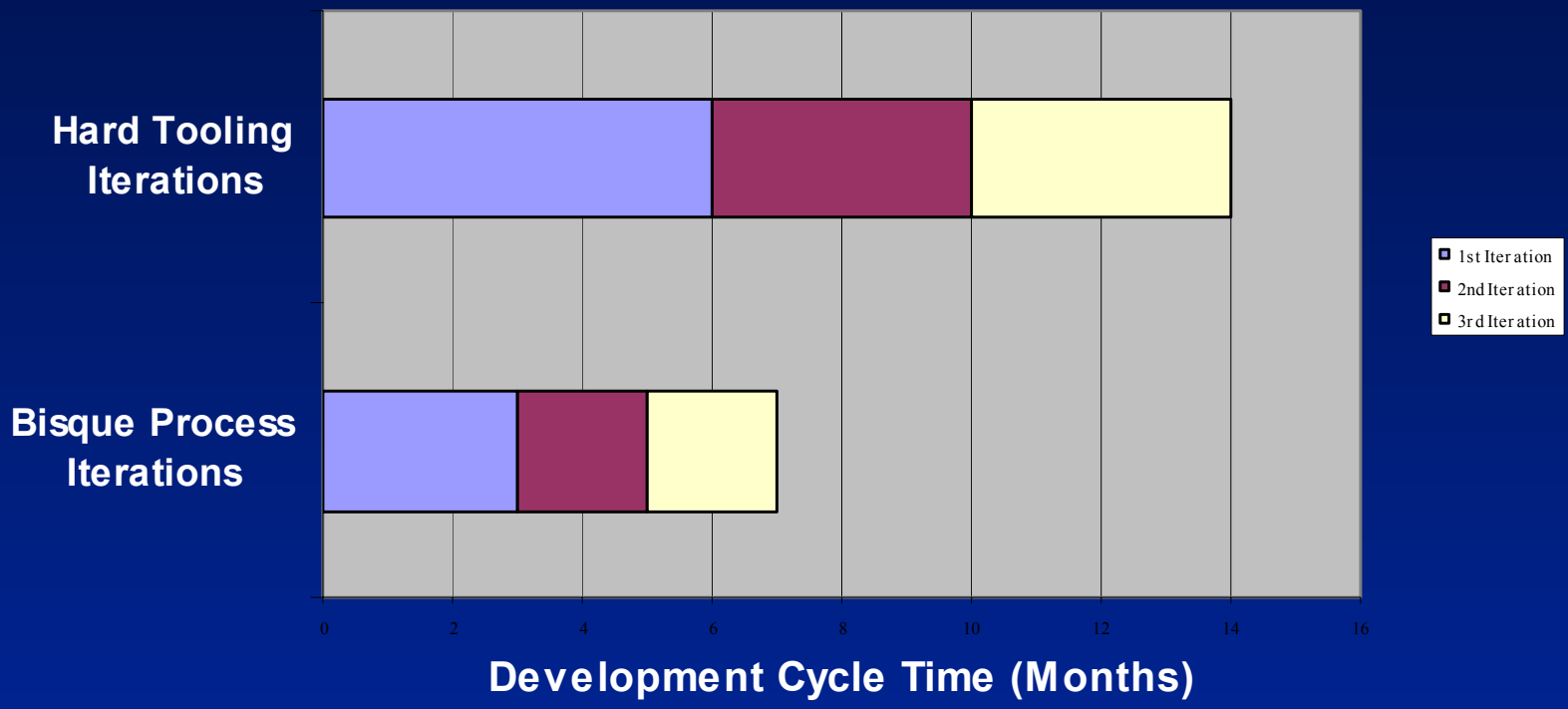
Bisque Processing Applied to Variety of Shapes

As fired tolerances +/- .75% per unit dimension

As-fired surface finish to 50 μ-inch Ra

Cost ~ 85% of Hybrid Molding for 300/year production

Bisque Processing Compresses Cycle Time



Bisque Processing Suitable for Complex Shapes

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Brittle Material Toll Services

- Forming
- Machining/Grinding
- Non Oxide Materials Sintering/HIP
- Laboratory Analysis